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ABUNDANCE AND COMPOSITION OF BENTHIC FAUNA IN *PENAEUS MONODON* FABRICIUS CULTURE POND ON THE WEST COAST OF MALAYSIA PENINSULAR

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ABSTRACT: This Paper reports a study on the benthic faunal abundance and diversity of tiger shrimp *P. monodon* culture ponds in Perak, west coast of Malaysia Peninsular. Sampling was carried out at three weeks interval throughout the 116 days culture period. In addition, water temperature, dissolved oxygen, salinity, transparency, pH and organic matter of soil were also measured. Results showed that the major groups of macro-benthos comprised of gastropod, foraminifera, polychaetes, bivalve and insects; whereas the meio-benthos comprised of harpacticoid copepods, ostracods, nematods, gastropods, foraminifera, bivalve, insects, crustacean nauplii and polychaetes. In macro-benthos, the abundance of different sizes of Gastropods increased throughout the culture duration. This consisted of 37 – 98.20% for <1 cm length, 1.80 – 61.50% for 1-2 cm length and 1.18 – 1.30% for >2 cm length. Other macro and meio-benthic organisms decreased linearly with the culture period. The depletion symptom indicates that the culture species may have intensively preyed upon the consumable (<0.5 cm in size) benthic fauna together with detritus and artificial diet; or could have been caused by pond bottom deterioration via uneaten feed, faces and toxic gases.

KEY WORDS: Benthos, Biodiversity, *Penaeus monodon,* Aquaculture, Malaysia.

INTRODUCTION

Benthic macro and meio-faunal communities play an important role in a culture pond ecosystem. Besides their trophic relationship, they are also a source of live or dead food for culture organisms. They are high in protein, fats, cellulose, lignin, starch, waxes and oils that supplemental feeds cannot provide (Kungvankij *el al.* 1986; Boyd, 1995). The composition of benthic biodiversity in the culture pond depends on the pond preparation, management and chemicals used. Benthic organisms were totally absent in poorly prepared pond bottom before the start of culture in Malaysia (Shariff *et al.* 2001). The information relating to the predation of benthic fauna by shrimps is available (Chong and Sasekumar, 1981; Marte, 1982; El Hag, 1984), however, benthic faunal diversity study in brackish water shrimp ponds is meager. Therefore, this paper aims to present the various groups of benthic fauna found in shrimp culture ponds in the West coast of the Malaysia Peninsular. The variation of total benthic fauna throughout the culture period was also observed.

MATERIALS AND METHODS

The study area is situated at Kampung Telega Nanas (5° 45′ N and 101° 37′ E), Perak, west coast of Malaysia and the ponds are about 8 years old. Three culture ponds were selected initially, but White Spot Syndrome Virus (WSSV) infected the two ponds during the middle of cycle period with only one pond remained uninfected. Therefore, sampling was carried out in one pond (4673 m^2) till end of 116 days cycle period.

The culture pond was prepared by draining and drying. Surface sludge was removed manually by water jet. Lime was applied at 2.9 t, 0.55 t and 3.8 t for $CaCO_3$, $Ca(OH)_2$ and dolomite, respectively. Tea seed cakes (TSC) were used at 0.1 t. Initially, the ponds were filter-pumped through a 400 – 500μm mesh net with about 20.0 – 30.0 cm seawater from the reservoir and kept for 1 week allowing phytoplankton to grow. The water depth was then adjusted to 1 m. Stocking density was 48 PL_{22}/m^2. A set of four paddlewheels for surface water circulation (12 h/d) and compressed air line for bottom aeration was used. The paddlewheels were increased to six after 1 month. During the culture period 10-20% of water was changed five times. The water was discharged through the channel to the adjacent mangrove swamps and refilled through pump from the reservoir. Other chemicals were used in following manner during the culture period; P_2O_5-20 kg, Zeolite-200 kg, Biosystem-1.2 kg, Aquakit-450 g, Bacterial substrate-68.22 l, Lacto bacillus-12.0 l, HUFA-11.6 l, Lacpan-202 g, Flumequine-130 g, Oxolinicacid-125 g, Norfloxacin-446 g, Molasses-11.5 kg, Rice bran-12.5 kg and boiled fish-5 kg per pond (4673 m^2).

Water quality parameters were measured at every three-week intervals, dissolved oxygen (DO) by DO meter (YSI model 57), water salinity and temperature by SCT meter (YS model 33), water pH by pH meter (EDT model FE 253) and transparency by Secchi Disk.

For organic matter, the Ekman grab was used to collect soil from four sampling locations of the pond. Samples were brought back to laboratory within 2-4 hrs of collection for further analysis. In the laboratory, soil samples were dried at room temperature (27$\pm$0.5°C) and then sieved through 200 μm mesh screen. Organic matter in soil was detected by ignition method (Boyd, 1995).

The abundance of macro and meio-benthos was investigated at every three weeks interval. The Ekman Grab sampler, which covered an area at 225 cm^2, was used for macro-benthos collection from four sampling location of the pond. For meio-benthos, Ekman Grab sampler was brought down into the sediment as slowly as possible by using a long bar instead of rope to avoid the disturbance of pond bottom. Later, 2 cm tube core was used inside the Ekman Grab to collect meio-benthos (Prof. Dr. Yoshihisa Shirayama, University of Tokyo, personal communication). All samples were preserved immediately in 10% buffered formalin mixed with Rose Bengal. In the laboratory, samples were sieved through 1000 μm mesh screen to retain macro-benthos and 53 μm mesh screen for meio-benthos. The organisms were counted and calculated for total amount in m^2 for macro-benthos and 10 cm^2 for meio-benthos.

RESULTS AND DISCUSSION

Data on DO, salinity, temperature, pH, transparency and soil organic matter are given in Table 1. Culture water parameters play important roles for the culture species in which they grow. Compared with the earlier studies (Banerjee, 1967; Apud *et al.* 1983) the pond parameters were found suitable for shrimp culture. Soil organic matter decreased with the culture time, probably as a result of using bacterial products (probiotics) in the ponds. This symptom indicated that probiotics probably help to maintain the good quality of culture pond bottom. Heterotrophic microorganisms or nitrifying bacteria decomposed or mineralized the organic matter in the pond ecosystem, while they consume oxygen and release CO_2 and ammonia during oxidization of organic matter (Moriarty, 1996).

Table 1. Water quality parameters and soil organic matter of shrimp culture pond.

Parameters	Range	Mean
DO (mg/l)	6.80-10.30	8.63±1.06
Salinity (‰)	16.0-28.2	21.96±3.81
Temperature (°C)	30.0-32.0	31.27±0.56
Water pH	7.22-8.44	7.95±0.39
Transparency (cm)	17.0-37.0	27.67±7.25
SOM (% dry weight)	2.70-7.20	3.69±1.59

SOM=Soil organic matter

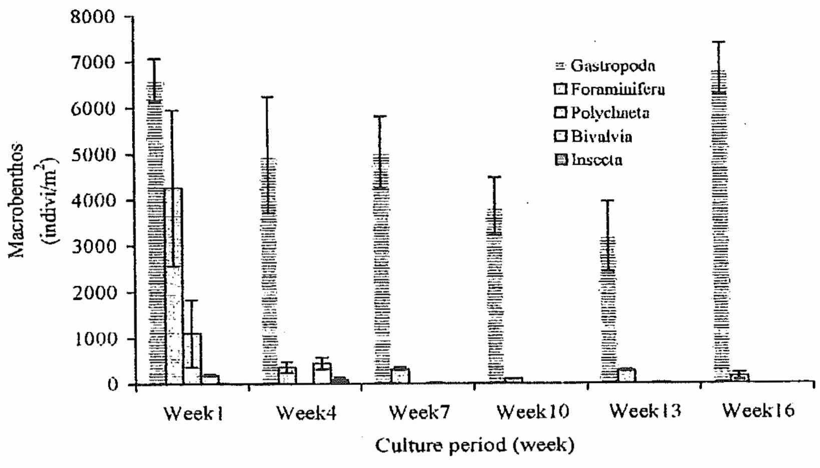

Fig. 1. Composition of macro-benthos in shrimp culture pond throughout the culture period.

The major groups of macro-benthos comprised of gastropoda, foraminifera, polychaeta, bivalvia and insecta, whereas, meio-benthos comprised of harpacticoid copepoda, ostracoda, nematoda, foraminifera, bivalvia, insecta, crustacean nauplii and polychaeta (Table 2). The variation of benthic faunal composition throughout the culture cycle is given in Fig. 1 and 2. The abundance of different sizes of macro gastropods were found to be increased throughout the culture duration which was consisted of 37 – 98.20%, 1.80 – 61.50% and 1.18 – 1.30% for <1 cm, 1-2 cm, >2 cm in length, respectively. This fluctuation of gastropod abundance may be due to the rejection c larger (1.0 – 2.0 cm) *Telescopium telescopium,* which shrimps probably were unable t consume. The other group of benthic organisms both in macro and meio-benthos wa decreased linearly with the culture period. The depletion symptom indicates that cultur species may have intensively preyed upon the consumable (<0.5 cm in size) benthi fauna. However, the pond bottom had deteriorated through uneaten feed, faces and toxi gases probably also affect its abundance and composition. Decrease of total benthi organisms density was also observed in ponds where the shrimps were fed wit supplemental diets (Tidwell *et al.* 1995; Shishehchian and Yusoff 1999).

Table 2. Major groups of macro and meio-benthos in the shrimp culture pond.

Major groups	Macro-benthos	Major groups	Meio-benthos
Mollusca		Mollusca	
Gastropoda	*Stenothyra polita*	Gastropoda	*Littorina* sp.
	Cerithidea cingulata		*Salinator* sp.
	Telescopium telescopim		*Cerithidea* sp.
	Littorina melanostoma		
	Fairbankia sp.	Bivalvia	*Modiolus* sp.
	Syncera brevicula		*Gelonia* sp.
	Turritella sp.	Annelida	
	Nassarius suturalis	Polychaeta	Syllidae (F)
	Morula musiva		*Pectinaria* sp.
Bivalvia	*Modiolus nitidus*	Insecta	*Culicoides* sp.
	Gelonia ceylonica		*Psephenivorus* sp.
Annelida			*Bezzia* sp.
Polychaeta	*Namalycastis* sp.		*Sminthurus* sp.
	Capitellidae (F)		*Cricotopus* sp.
	Archannelida (F)		Hydrachnellidae (F)
	Terebellidae (F)		Pentatomidae (F)
Insecta	*Cricotopus* sp.	Foraminifera	Foraminifera (F)
		Nematoda	*Spirina* sp.
			Halalaimus sp.
			Sabateria sp.
Foraminifera	Foraminifera (F)	Crustacea	Crustacean nauplii
		Copepoda	*Euterpina acutifrons*
			Tegastes sp.
			Nitokra affinis
			Microsetella sp.
			Enhydrosoma sp.
		Ostracoda	*Cypridina* sp.

F=Family

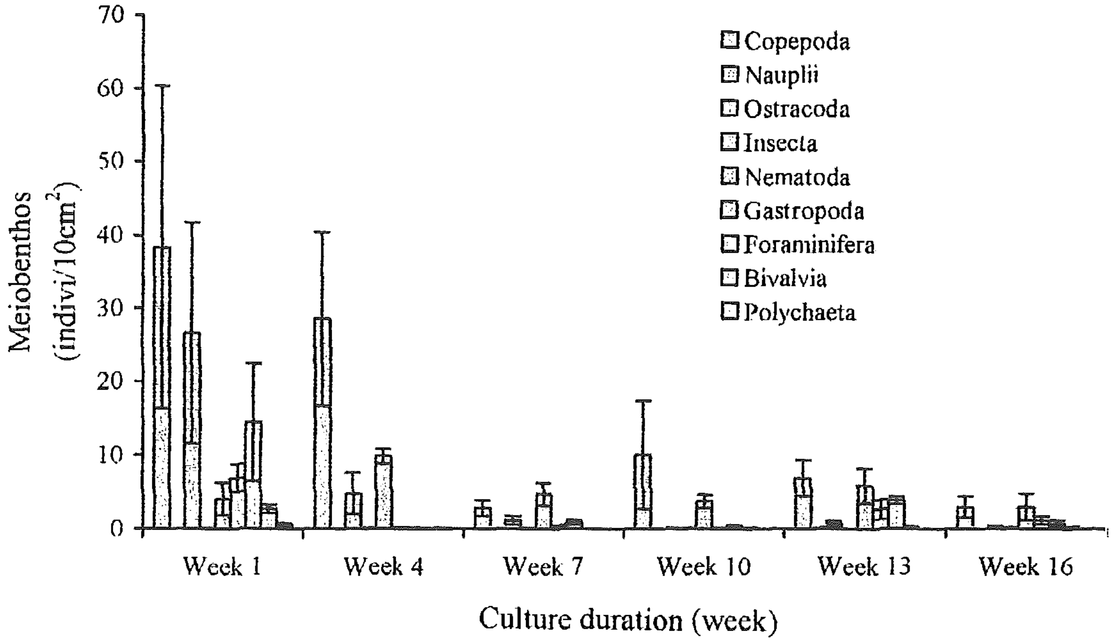

Fig. 2. Composition of macro-benthos in shrimp culture pond throughout the culture period.

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